BREAKING OUT BALES OF COTTON STORED ON HEAD

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SUMMARY

There are a number of patterns or arrangements in which bales of cotton can be stored. In general, these storage arrangements differ with respect to the accessibility of given random bales, and therefore with respect to the effort, time, and cost involved in breaking such bales out of storage.

Among the preferred arrangements is one in which flat bales are stored on head 2 bales high in paired rows, each pair being separated from adjacent pairs by lateral aisles. Thus, any bale in any row may be reached directly from an aisle, although it often may be necessary to move an upper-tier bale to facilitate the removal of a lower-tier bale. Breaking out of such stacks is usually done by 1 of 3 methods:

1. Manual (the most common) with a 4-man crew breaking out 20 bales an hour.

2. Boom truck and 3 men breaking out 50 bales an hour.

3. Lift truck and 1 man breaking out 50 (or more) bales an hour.

Assuming wages of $1 an hour for manual labor, $1.25 for lift-truck operators, and $1.25 an hour for owning and operating a lift truck, the approximate direct costs for breaking out 100 bales are, respectively, $20, $9, and $5.

The equipment and procedures used in the third--and lowest cost--method also can be used effectively in such operations as breaking out compressed bales stored on head, tightening up, storing bales in partially depleted stacks, resampling, and reweighing.

BREAKING OUT BALES OF COTTON STORED ON HEAD

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INTRODUCTION

Storage is a principal service provided by cotton compresses and warehouses. The single, physical operation of placing bales in a block or stack--after delivery to the storage point--is called storing, as distinguished from other handling operations. It is the final handling operation in receiving bales, and is preceded by unloading (from railroad cars or motortrucks), weighing, sampling, and transporting to the storage area. Normally, bales are stored in blocks or stacks separated by a main or center aisle that runs completely through the storage compartment, and usually by feeder or lateral aisles that branch off the main aisle (fig. 1).

Bales are removed from storage through an operation known as breaking out. This operation consists of removing bales from blocks or stacks and setting them in a temporary block in the main aisle for later pick-up by transporting equipment. Transporting these bales from the storage area to the loading platform, compress area, or to any other part of the warehouse is regarded as a separate operation.

Either flat or compressed bales may be stored in various arrangements. For example, flat bales may be stored 1, 2, or 3 high on head, with various row and aisle spacings. They may be stacked 4, 5, or more bales high on side. Other storage patterns may be used.

Different kinds of storage arrangements are likely to involve different handling costs, because of differences in: (1) Storing costs and (2) break-out costs. For any particular storage arrangement, the costs of storing and of breaking out also are affected by the methods used. 1/ A change in methods may result in a greater change in handling costs than would a change in the storage arrangement.

Breaking bales out of storage generally is more costly than placing them in storage. This is partly because breaking out usually is a much slower operation. Often 100 to 200 bales can be stored in an hour, but the break-out rate from these stacks may be only 10 to 20 bales an hour.

1/ The term "method" as used in this report refers to the way or manner in which labor and equipment are used together to perform a particular handling operation, such as storing and breaking out. Any given method involves a specified number of workers, a specified type or combination of types of equipment, and a specified procedure for performing the operation.

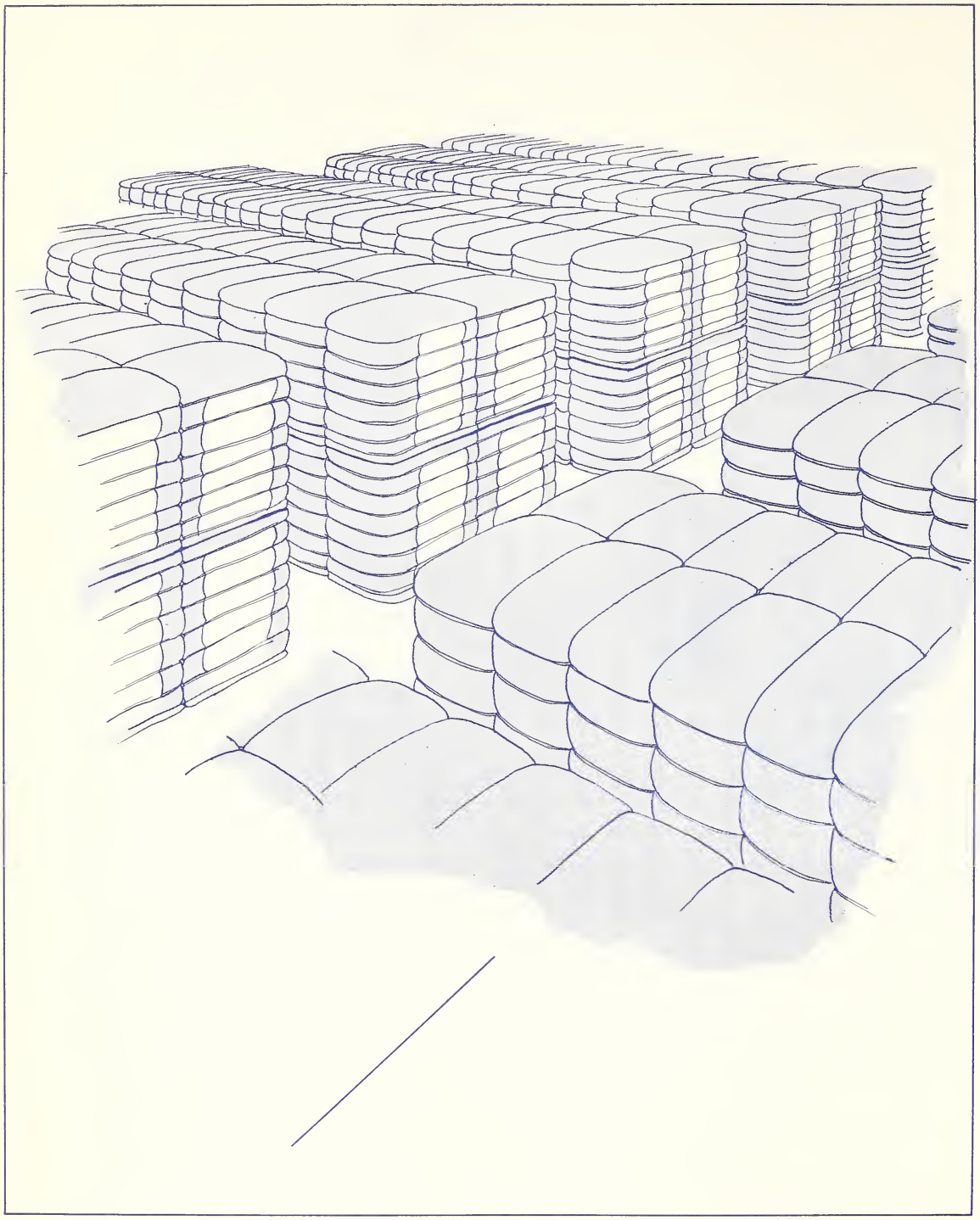

Figure 1.--Overhead cutaway view of a storage compartment showing flat bales of cotton stored in 2-high, on-head stacks on each side of the main aisle. The stacks are about 20 bales in length and are separated by lateral aisles about 4 feet wide.

In storing it usually is possible to place all bales directly as they come, without the necessity of handling any bales other than the particular bales being stored (fig. 2).

In breaking out bales, however, it is necessary with most storage arrangements to handle a good many bales other than those broken out, especially if these are scattered more or less at random in a block or stack (fig. 3). Extra handling is particularly likely if bales are stored in large blocks with few or no feeder aisles, or if bales are "cordwooded" several bales high on side. Such conditions may force workers to move many bales to get at the one bale wanted. The total number of obstructing bales that must be handled depends primarily on the length of the rows in untiered blocks, or on the height of the stacks in tiered blocks, and on the number and position of the bales to be broken out. Also, after one or more break-outs it may take further rehandling to "roll back" or "tighten up" blocks or stacks to make room for new bales.

Tightening up often involves rehandling all of the obstructing bales removed during break-out operations and, in some cases, a number of additional bales. Because tightening up requires additional time and frequently is quite costly, many warehousemen resort to it only when storage space is at a premium. Other warehousemen, because they believe periodic tightening up to be essential to good housekeeping, may do it without regard to the availability of storage space.

Except when storage space is at a premium or when facility designs or other considerations will not permit, most warehousemen use storage arrangements that tend to minimize the number of times bales are handled, particularly in breaking out. Accordingly, many warehousemen store bales in such a way as to provide direct and relatively easy access from an aisle to any bale in the block. Among the arrangements which have this advantage are those in which flat bales are stored on head, flat sides together, in a series of double or paired rows, the different pairs of rows being separated from other pairs by lateral or feeder aisles. The row stacks may be 1, 2, or 3 bales high, depending on the quantity of bales to be stored and the amount of space available. Stacks 2 bales high are most widely used (fig. 1).

The length of rows depends largely on the dimensions and general layout of the storage compartment. In warehouses having small compartments, rows may extend only 5 or 6 bales in depth from the main aisle. In warehouses having large compartments, rows 40 bales in depth may be used. Rows of from 10 to 20 bales in depth are fairly common.

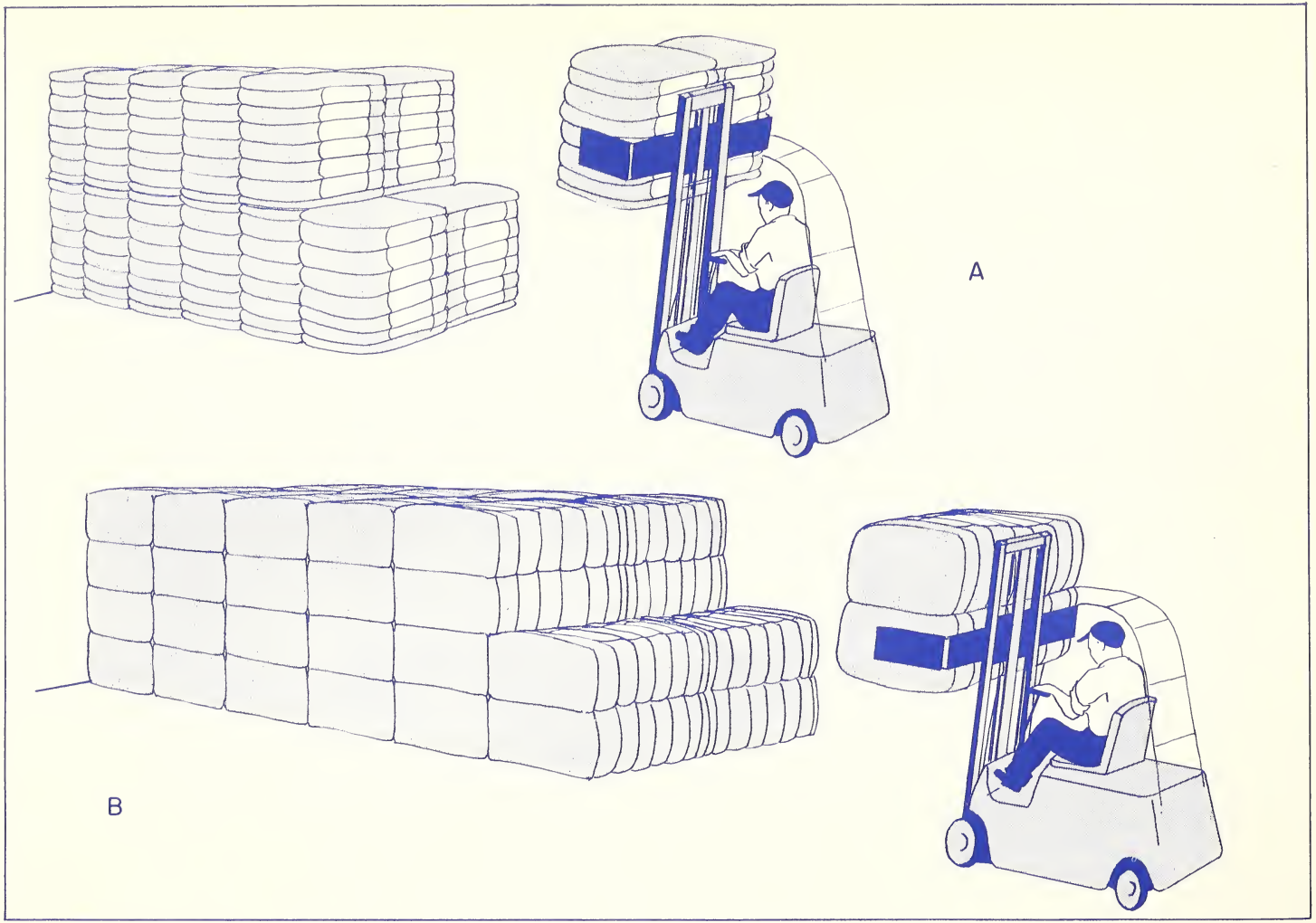

Figure 2.--Machine method of stacking flat bales of cotton: (A) Side view of partially completed row stack of flat bales 2 high on head, with clamp truck raising two bales to be placed in upper tier. (B) Side view of partially completed row of flat bales in a 4-high cordwood stack, with clamp truck raising two bales to be placed in upper tier. Where enough room is available, the clamp truck may be used to build a stack from the side, rather than from the end of the row.

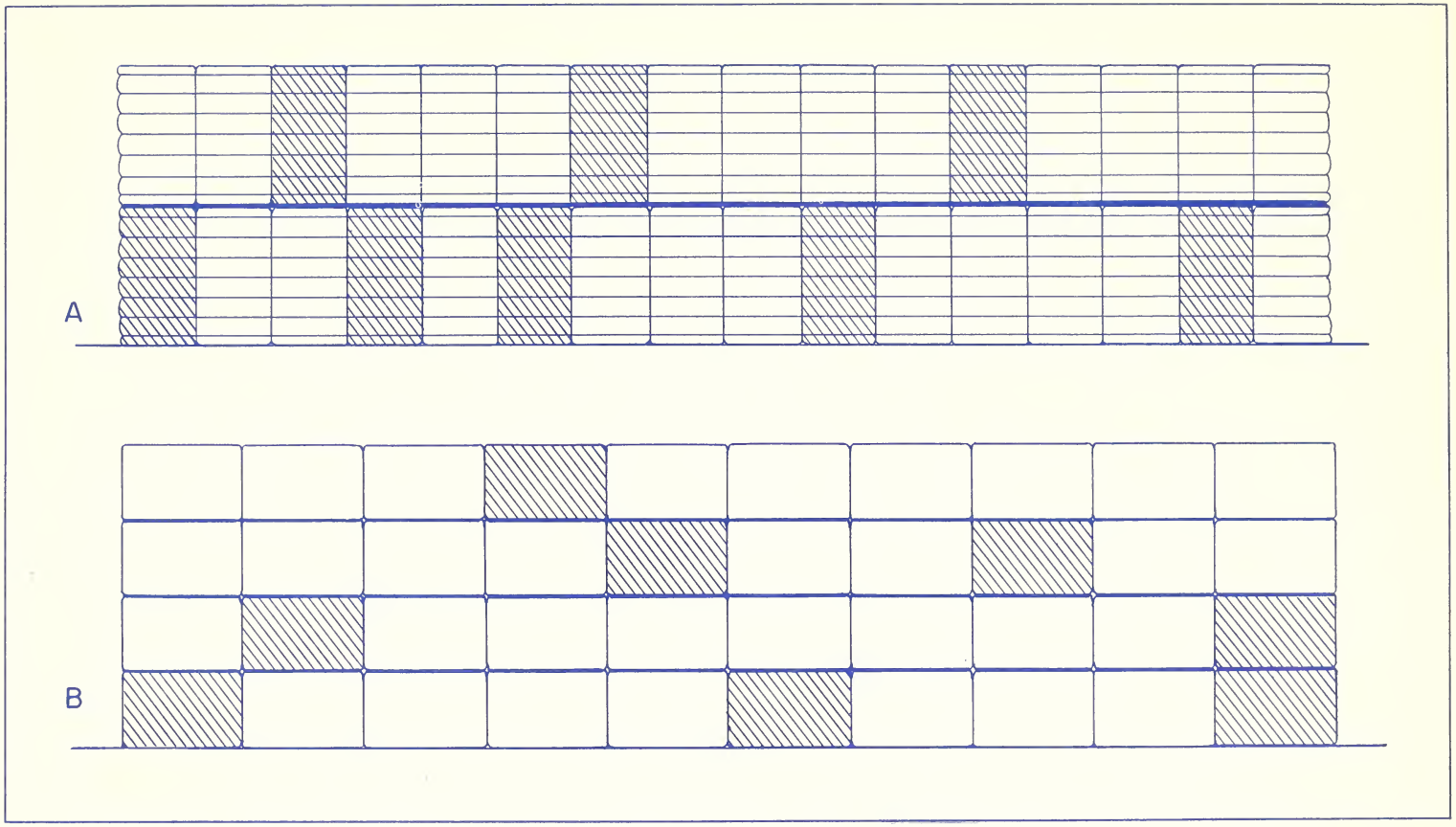

Figure 3.--Stacks of bales of cotton before break-out: (A) Side view of full row stack of flat bales 2 high on head with selected bales shaded, representing bales to be broken out. (B) Side view of full row stack of flat bales in 4-high cordwood arrangement with selected bales shaded, representing bales to be broken out. In both types of stacks, the bales directly above any desired (shaded) bales are "obstructing" bales which, ordinarily, must first be removed to obtain access to the desired bales. In some situations where there is no lateral aisle along such a row stack, all or most of the bales between any desired bale and the main aisle must be removed before such bale can be broken out. When row stacks such as the one shown in (A) are separated by lateral aisles, either as individual or as paired rows, the number of obstructing bales requiring removal is minimized.

In a number of warehouses the lateral aisles are slightly more than 4 feet wide. 2/ Where hand trucks are used in break-out operations, such width permits most bales to be hand trucked "on the flat"--that is, with the flat side resting on the truck--to the main aisle. To gain storage space, conform to column spacing, or for other reasons, other warehouses use a lateral aisle several inches narrower, and bales then must be hand trucked "on the edge" to the main aisle. The difficulty of break-out operations is increased as the lateral aisle is narrowed and the work room needed in the aisle for proper jockeying of bales is reduced. An aisle width of slightly more than 4 feet usually is considered adequate for the types of break-out methods discussed in this report. However, a width of about 3½ feet may be satisfactory for some methods. A width much less than this is likely to be seriously restrictive. As previously indicated, however, aisle widths in many cases are determined by the spacing of the columns or pillars in the compartment, by the need for storage space, or by other factors, rather than by the requirements for efficient and economical handling. Under certain storage conditions, aisle widths are determined chiefly by insurance requirements.

Most warehouses that store flat bales in the two-rows-and-an-aisle arrangement use manual break-out methods. Three or four workers usually are required for a break-out crew. Although the initial storage blocks or stacks may have been built by a clamp-type industrial power truck, as enough working space for such a machine usually is available when stacks are first built, a clamp truck ordinarily cannot be used later to make direct break-outs of bales from such blocks. In most warehouses the lateral aisles, from which access to bales ordinarily is obtained, are not wide enough to permit a clamp truck to make the right angle turns required to put the truck in a position to grasp any given bale and pull it from the row or stack. Aisles wide enough for this purpose usually are not practical because of the large amount of storage space that would be lost. 3/

2/ Some warehousemen fill in lateral aisles with bales placed one high on head, thus eliminating them as "aisles." Although this practice increases the storage capacity of the warehouse, it also greatly increases break-out and other handling costs, and for this reason is ordinarily to be avoided.

3/ It would be possible, of course, to use clamp trucks completely to break down all or part of a row by working directly down the row--rather than down the lateral aisle--from the center aisle toward the wall, removing each obstructing bale in turn until each desired bale has been reached and broken out. Whereas under certain conditions this method may be practical with very short rows, it would not be practical with very long rows, especially when only a small proportion of the bales are to be broken out. This is so because in getting to such bales, most or all of the other bales in the row also would have to be handled.

Some warehousemen use a boom truck for breaking out bales. The boom truck is a high-lift industrial power truck equipped with a free swinging boom (sometimes called a cotton topping boom) from which cotton bale hooks are suspended. Although this type of truck is used most commonly to stack and break out compressed bales in cordwood stacks, it also is sometimes used for the same purposes where flat bales are stacked, end on end, two or more bales high. As the boom and hooks can be swung to either side of the truck, it is unnecessary for the truck to turn to face the storage block in order to remove a bale. Therefore, even though they are not always desirable, relatively narrow aisles frequently can be used. In the extreme case, the lateral aisles need only to be wide enough throughout to accommodate the width of the machine itself. The boom truck has at least one major disadvantage, however. The truck and operator cannot do any kind of bale handling without manual assistance from other workers who attach or release hooks, guide the movement of bales, and serve in other capacities. In break-out operations with a boom truck, a crew of 3 or 4 workers is required. This is roughly the same size crew as used in manual break-out operations. As in other operations in which several men work together as a crew, idle or wait time is likely to develop and to lower efficiency.

A recent development is a special break-out attachment for powered lift trucks, by means of which bales can be broken out of on-head storage entirely by a machine and its operator. 4/ This attachment is now used in a number of compresses and warehouses. Although some of its potential uses have not been fully explored, enough information is available to indicate how use of this attachment in breaking out compares with the manual and manual-boom truck methods. The chief purpose of this report is to compare the efficiency of these three methods. 5/

COMPARISON OF 3 METHODS OF BREAKING OUT FLAT BALES STORED 2 HIGH ON HEAD

The most widely used arrangement for storing flat bales on head in a basic two-rows-and-an-aisle pattern is one in which each row is "topped" to form row stacks 2 bales high. 6/ The three break-out methods previously

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4/ This attachment was designed by Jack Garrett, superintendent of a cotton compress and warehouse in Waco, Tex.

5/ No endorsement, specific or implied, is intended for the use of any given method or type of equipment under all conditions. The final section of this report, entitled "Some Factors to be Considered in the Purchase of Break-out Equipment," has been provided for the guidance of warehousemen concerned with certain facility or equipment problems.

6/ Some warehousemen refer to this type of stack as "head on head" storage. This term might apply equally, of course, to any other type of arrangement in which bales are stacked two or more high on head.

noted will be discussed in this section in terms of their application to 2-high row stacks. Their application, where appropriate, to 1-high and 3-high stacks may be regarded as variations of the procedures described for 2-high stacks.

Manual Method

The manual or hand method currently is the most widely used method of breaking out flat bales stored on head. Hand methods also are used extensively for breaking out bales from other kinds of storage arrangements.

The manual method of breaking out bales from 2-high stacks usually requires a crew of 3 or 4 workers. Most commonly, 2 or 3 workers serve as break-out men and 1 worker as a hand trucker. In some cases more than 1 trucker is used to transport bales to the main aisle. Time studies show that this practice usually is inefficient. Even when only 1 hand trucker is used, he is likely to be idle much or most of the time, and the use of a second hand trucker merely increases such idle or wait time without obtaining any significant increase in the rate of break-out.

With the manual method, the break-out men, using their hands and bale hooks, manually jockey the desired bale out of the row or stack into the lateral aisle and load it onto a hand truck (fig. 4). The hand trucker transports the bale to a set-down area in the main aisle and unloads it into a temporary block. Bales are held in the temporary block until they are picked up to be transported to the press room, loading-out platform, or other area. After placing a bale in the temporary block the hand trucker returns to the break-out point to pick up another bale. This cycle is repeated for each bale that is broken out. Bales in the upper tier of a row stack are pulled out by hand from below, pushed out from above, or rocked out. In any case, once free of the stack, they are simply allowed to drop into the aisle. Bales in the bottom tier are rocked, dragged, pinched, or walked out. Bottom-tier bales that are tightly wedged between adjacent bales usually are first pinched out part of the way by the hand trucker, who pries the bale out with the nose prongs of the truck. The break-out men then pull the bale until it is free of the stack. Some crews remove and set aside any unwanted upper-tier bale before breaking out the desired bale directly below. Other crews simply pinch out the lower bale, letting the upper bale drop into place in the space vacated.

The manual method is both slow and costly. When a 4-man crew is employed, break-out rates usually run about 20 bales per hour, although in some situations or for short periods they may range considerably above or below this rate. At this rate, 5 hours of elapsed time, or 20 man-hours of labor, are required for breaking out 100 bales. In addition, 5 equipment-hours of hand-truck time are required. Assuming a

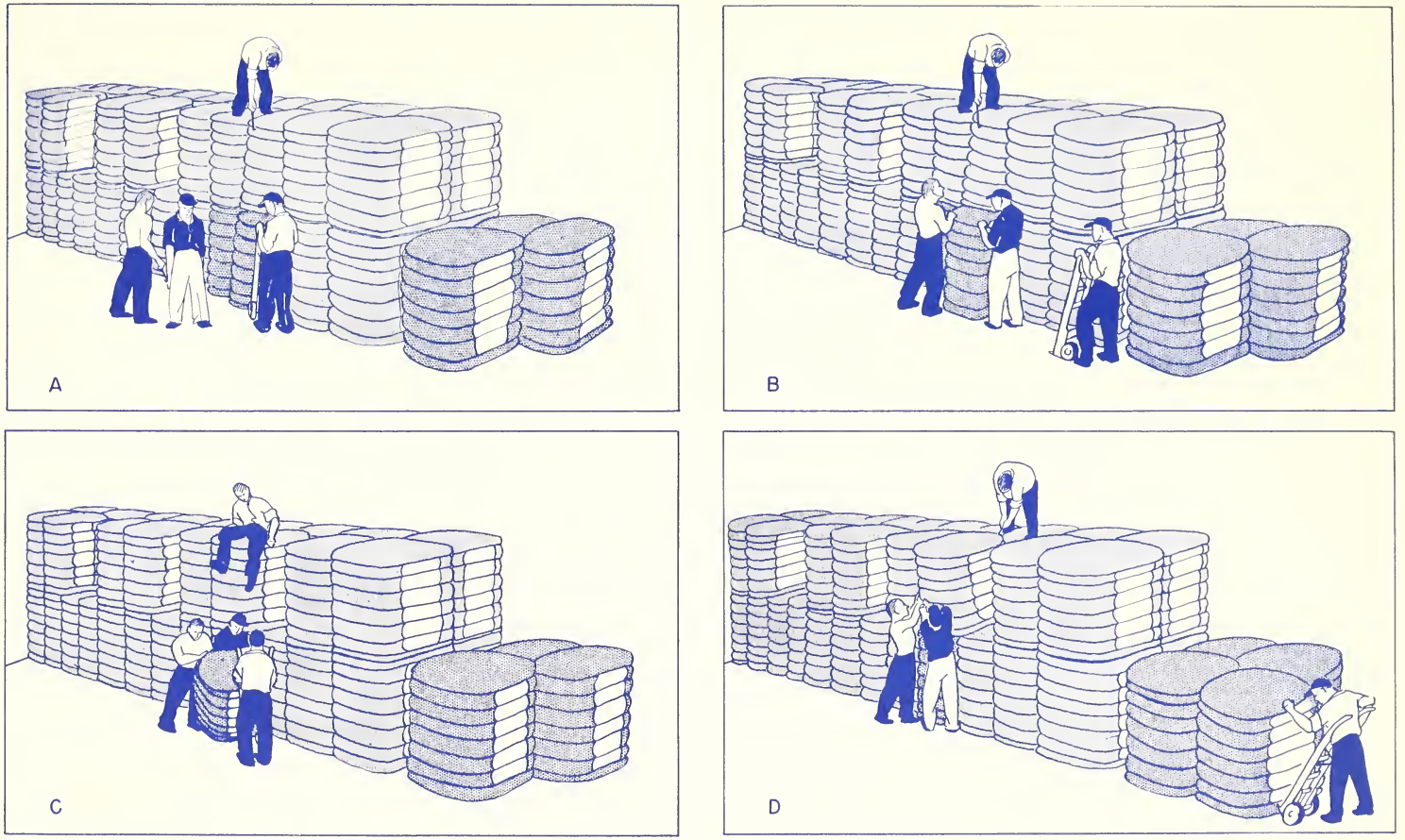

Figure 4.--Manual method of breaking out bales of cotton (desired bales are indicated by darker shading): (A) Hand trucker beginning to pinch out bottom-tier bale while break-out man on top of stack lifts obstructing upper-tier bale slightly to relieve pressure on bale being broken out. (B) Two break-out men continuing maneuver of bale into lateral aisle. (C) Bale being loaded onto hand truck; top-tier bale has dropped into space left open by removal of the bottom-tier bale (the top-tier bale is sometimes pushed out into the aisle and set aside before breaking out the bottom-tier bale). (D) Hand trucker placing same bale in temporary block in set-down area in main aisle; break-out men shifting a top-tier bale into open space at right in order more easily to break out desired bottom-tier bale below.

wage rate of $1 per hour and an equipment cost rate for hand trucks of $0.03 per hour, the direct labor and equipment costs for breaking out 100 bales with a 4-man crew would be $20.15. 7/

One of the reasons for the relative inefficiency of the manual method is that in some situations or at some times the break-out men may spend as much as 40 to 50 percent of their time waiting for the hand trucker to complete the pinch-out of a bale or to return after carrying a bale to the main aisle, whereas in other situations or at other times the hand trucker may be idle more than 75 percent of the time waiting for the break-out men to complete their tasks. Much of this wait time is inherent in the manual method and cannot easily be reduced.

Manual-Boom Truck Method

The boom truck is used in only a few warehouses for breaking out flat bales stacked on head. It is used more extensively to stack and break out compressed bales in a cordwood storage arrangement. In most warehouses where flat bales are stacked on head, they are broken out manually. However, despite the disadvantages of the manual-boom truck method, it is much more efficient than the purely manual method.

Ordinarily, the boom attachment employed in this method is used only on lift trucks having a capacity of 3,000 pounds or more. The crews required in boom-truck break-outs vary from 3 to 4 workers, as in the case of the manual method. Such crews usually consist of 1 boom-truck operator, 1 or 2 hook men (depending on whether or not the truck is equipped with an elevating platform for the hook man), and 1 hand trucker. As in the manual method, the hand trucker transports bales to the main aisle after they have been removed from the stack. This transporting is done by hand truck because the boom truck is not well adapted to this part of the operation. However, the hand trucker usually does not assist in the removal of bales from the stack, as he does under the purely manual method, because that work can be done more efficiently by the boom truck.

For the break-out operation, the boom truck usually is first backed into the lateral aisle. Beginning at the main aisle and working backward down the lateral aisle toward the wall, the truck is used to break

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7/ For purposes of simplicity and convenience the hourly wage rates and equipment cost rates used in this and the following illustrations are assumed and not calculated costs. However, they approximate the actual labor and equipment costs of many cotton warehousemen. Some warehousemen, of course, may have costs considerably higher or lower than those assumed, and should make allowances for these differences in comparing the costs of different break-out methods.

out bales from stacks on each side of the aisle. Hook men, working on the floor and on the stack, attach and release the hooks which hold the bales, and manually assist in guiding each bale from its original position in the stack to a carrying position on the hand truck in the lateral aisle. As each bale is broken out of the stack, it is hand trucked to the main aisle and set down (fig. 5). The hand trucker then returns to the break-out point to repeat the cycle. 8/ Top-tier bales are broken out without the removal of other bales. Lower-tier bales usually are broken out by first removing any obstructing bale on top.

The manual-boom truck method is more efficient when a small, safe platform is attached to the face plate or elevating part of the truck's mast so that a hook man can ride up and down with the boom (fig. 6). By use of this device 1 hook man can perform the hooking and unhooking operations at both the top and bottom of the stack. When 2 hook men are used, 1 working in the aisle and the other on top of the stack, each worker is idle a relatively large part of the time.

Because of the wait time which under certain situations is experienced by the hook men and the hand trucker, the manual boom-truck method, like the manual method, often is very inefficient in its use of labor. Despite this deficiency, however, the boom-truck method, because of its use of powered equipment in place of hand labor in removing bales from the stack, is capable of a much faster break-out rate than that generally obtained with the purely manual method. With the manual-boom truck method, a break-out rate of 50 bales per hour usually can be achieved. At this rate 2 hours of elapsed time are required to break out 100 bales. If a 3-man crew (the crew size normally required for a platform-equipped boom truck) is used, labor requirements are 6 man-hours, of which 2 man-hours (the boom-truck operator's time) should be considered as semiskilled labor and 4 man-hours as unskilled labor. Equipment time is 2 hours for the boom truck and 2 hours for the hand truck. Assuming an hourly wage rate of $1.25 for the boom-truck operator and $1 for the hand trucker and hook man, the direct labor cost for breaking out 100 bales of flat cotton would amount to $6.50. Assuming an hourly cost rate of $1.25 for the boom truck and $0.03 for the hand truck, direct equipment

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8/ Greater efficiency can be obtained by separating the actual break-out operations from the hand trucking of bales to the main aisle. This is done by beginning the break-out at the wall and working toward the main aisle, leaving each bale in the lateral aisle for later removal by a hand truck. The purpose of this separation is to eliminate the wait time of the hand trucker and reduce the wait time of the other workers. For a more complete description of the procedure involved in effecting this separation, see "Cotton Handling Guide for Warehouse Managers and Foremen," U. S. Dept. Agr., Marketing Research Report No. 50.

Also of possible interest to the reader is "Some Improved Methods for Receiving Bales of Cotton in Compresses and Warehouses," U. S. Dept. Agr., Agriculture Information Bulletin No. 80.

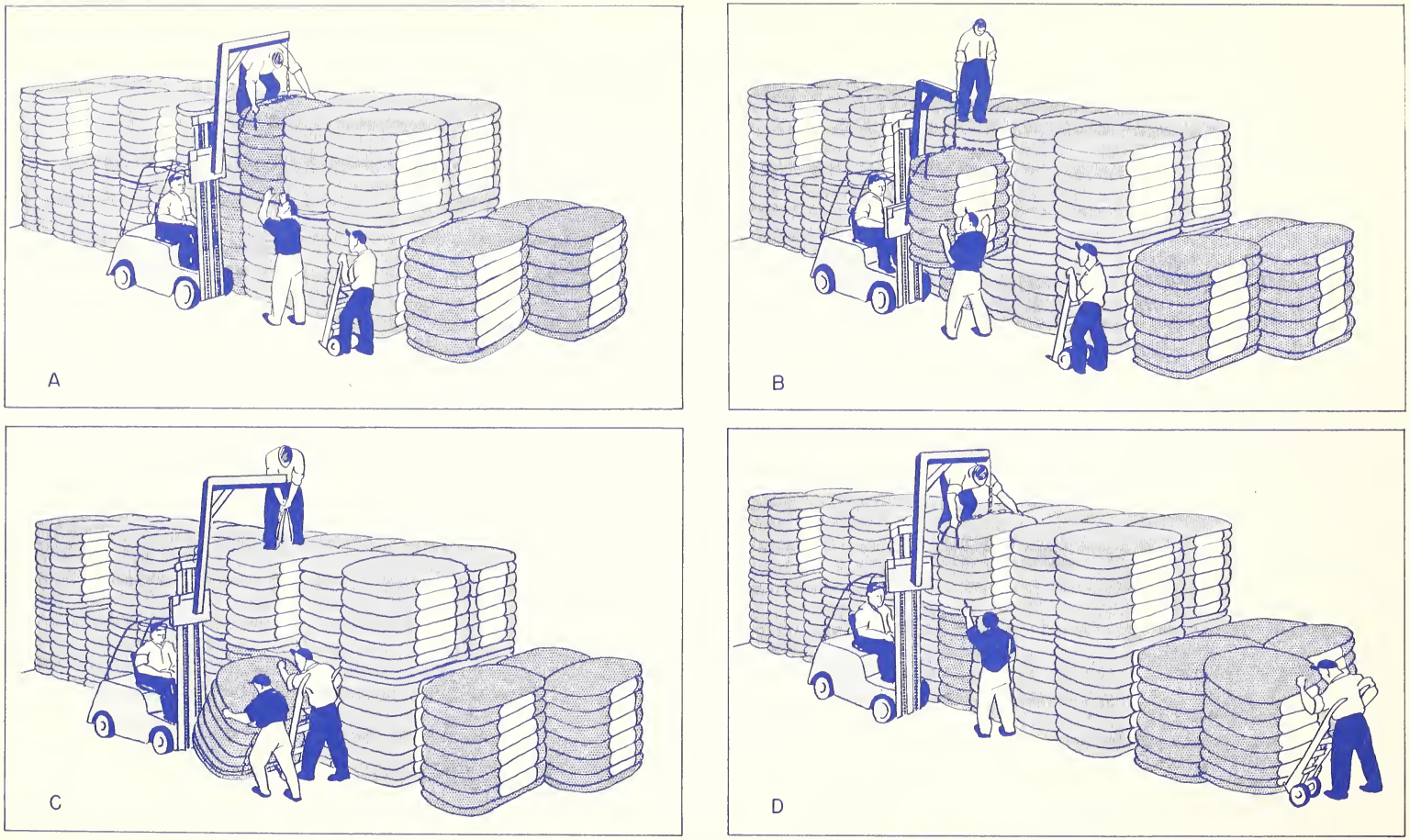

Figure 5.--Manual-boom truck method of breaking out bales of cotton (desired bales are indicated by darker shading): (A) Hook man on top of stack placing hooks in desired bale while man in aisle prepares to assist in guiding bale into lateral aisle. (B) Bale being lowered by boom truck after break-out from upper tier. (C) Bale being loaded onto hand truck. (D) Hand trucker placing bale in temporary block in set-down area in main aisle as remainder of crew prepares to shift a top-tier bale into open space at right in order more easily to break out desired bottom-tier bale below.

Figure 6.--Boom truck equipped with a platform on which a hook man can ride up and down with the boom. Use of such a platform saves the labor of 1 worker, as the placing of hooks on a bale of cotton at the top of the stack and releasing of the hooks at the bottom of the stack can be done by the same man.

costs would be $2.56 and would bring total direct labor and equipment cost per 100 bales to $9.06 or roughly 45 percent of the cost by the purely manual method.

Machine Method

The machine method of breaking out involves the use of a special break-out attachment for lift trucks. According to the manufacturer, the attachment can be used on any standard lift truck of "proper capacity." For this purpose, proper capacity usually is interpreted to mean 2,000 pounds or greater. This approximates the capacity of most clamp-type industrial trucks in current use in cotton warehouses. The

attachment consists of one upper arm, at the outer tip of which is a hook on which the bale is carried, and two lower arms, terminating in prongs, against which the bale rests. 9/ The upper arm supports the weight of the bale; the two lower arms merely serve to stabilize the load while in transit. Both upper and lower arms can be moved as a unit by hydraulic action controlled by the lift-truck operator. They can be raised or lowered, and can be swung approximately 85 degrees to the right or left from the center position (fig. 7). The attachment was first used early in 1951. Although a number of cotton warehousemen have since purchased and used the attachment, they represent at present a very small proportion of the warehousemen who use bale-stacking arrangements to which this machine method of breaking out is suited.

The attachment can be used to break out or otherwise handle bales on either side of a lift truck in a lateral aisle without turning the truck to face the bale. As with the boom truck, it is possible, although not necessarily desirable, to use the machine with the break-out attachment in relatively narrow lateral aisles, provided they are wide enough for free passage of the machine. Although the machine method has been used in 3-foot lateral aisles, warehousemen experienced in its use generally prefer aisles at least 4 feet wide. Aisles of this latter width provide room enough for most machine operators to use their equipment most effectively.

When breaking out is done with a lift truck having the special break-out attachment, it is a completely self-contained, one-man operation. With this device, the truck operator alone, without any help from other workers and using only the one machine, can do everything necessary to break out any bale accessible from a lateral aisle, and deliver it to the set-down point in the main aisle.

The usual procedure in breaking out bales is for the truck operator to drive his machine into the lateral aisle bordering the row stack from which bales are to be broken out, and proceed to a desired bale. When the bale is reached, the operator swings the arms of the attachment toward it and inserts the carrying hook on the upper arm into the narrow or ball side of the bale just below the second band from the top (fig. 8). After having securely engaged the bale, he lifts it by hydraulic action so as to clear the floor or the bale beneath, and then backs the lift truck so as to pull the bale outward into the aisle. The experienced operator usually inserts the hook and lifts the bale as a continuous action. As the bale is drawn clear of the storage row it is swung directly in front of the lift truck, ball side toward the operator, with the lower part of the bale resting against the prongs on the lower arms

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9/ The attachment itself is reported to have a net weight of 240 pounds.

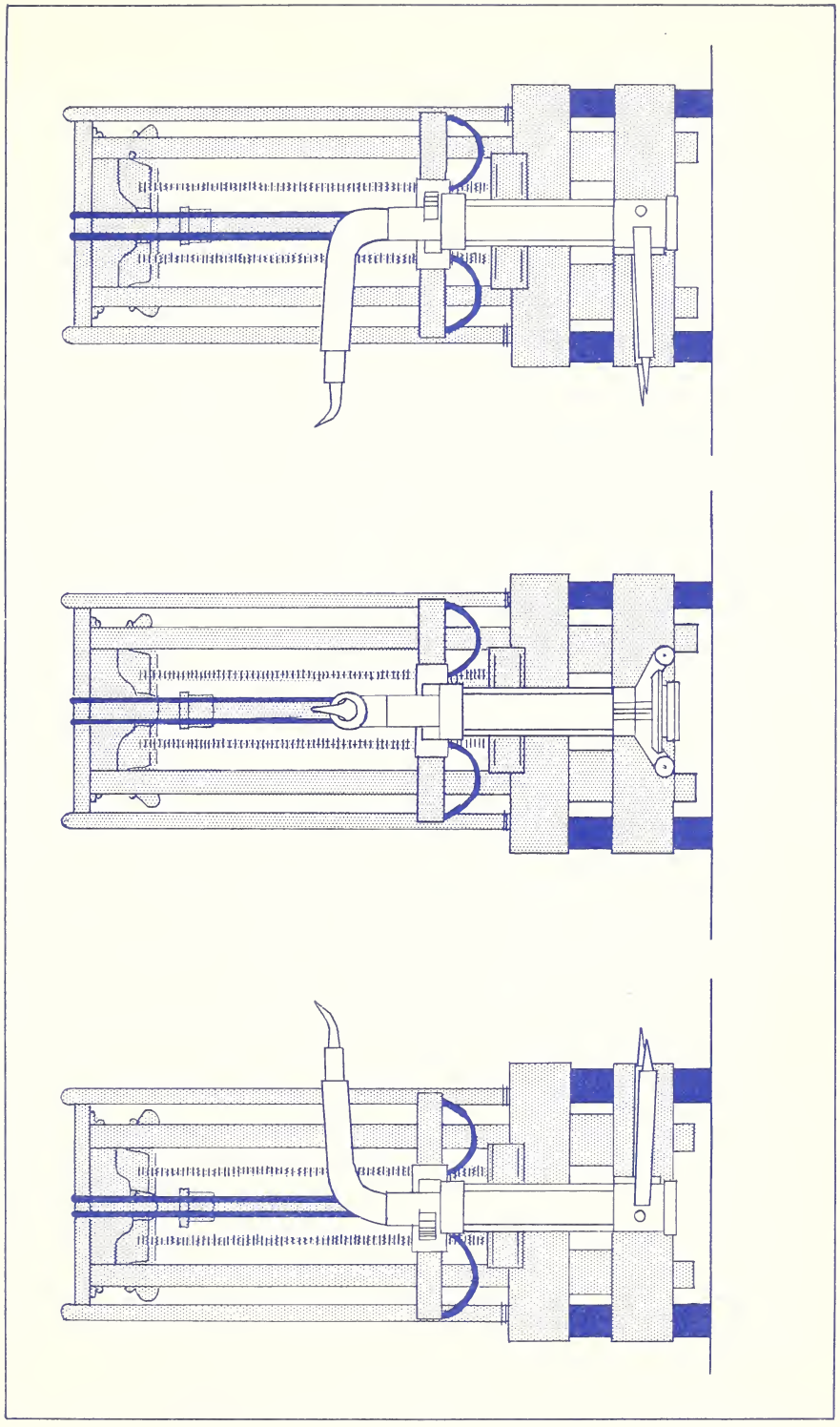

Figure 7.--Front view of mounted break-out attachment with arms shown in three positions. The arms may be swung approximately 85 degrees to the right or left from the center position.

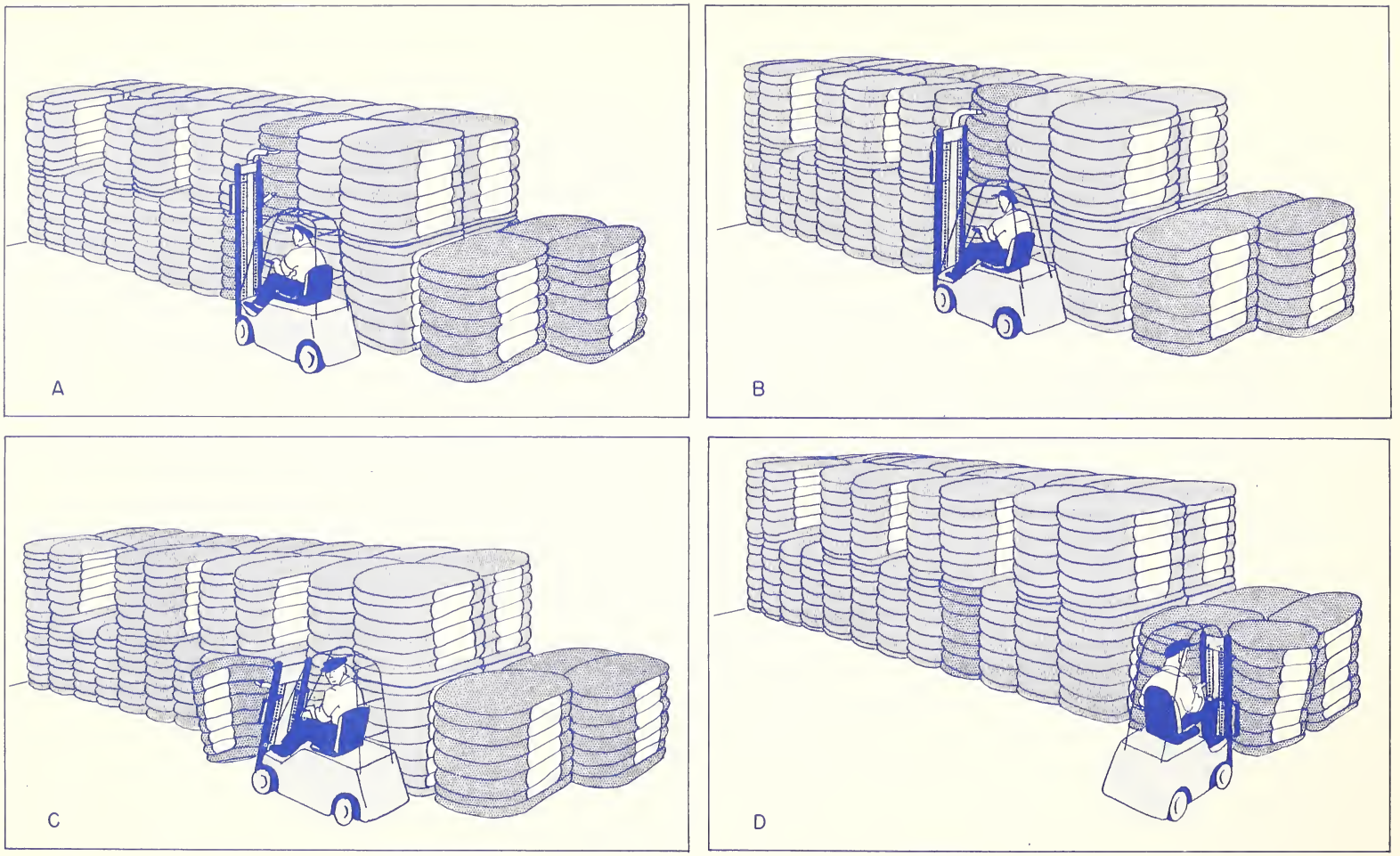

Figure 8.--Machine method of breaking out bales of cotton (desired bales are indicated by darker shading): (A) The carrying hook of break-out attachment being inserted beneath second band of desired bale. (B) Bale being lifted slightly preparatory to being pulled into aisle by operator's swinging attachment to left and backing truck. (C) Operator backing truck toward main aisle with bale suspended in front of truck. (D) Bale being placed in temporary block in set-down area.

of the attachment, and is transported to the set-down area in the main aisle. As soon as the bale is deposited in the set-down area, the lift truck returns to the break-out point to repeat the cycle.

Usually, bales in the upper tier of a row stack can be broken out without handling other bales. To break out a bale from the bottom tier, however, it usually is necessary first to remove the top bale. However, where conditions are favorable a highly skilled operator can break out a bottom bale without first setting aside the top bale. In such cases, he simply pulls the lower bale out from under the upper bale, allowing the upper bale to fall into the space left open. Operations have been observed in which the lift-truck operator broke out lower-tier bales in this manner at a rate that did not differ appreciably from that at which he was able to break out upper-tier bales. A disadvantage of this procedure, however, is that frequently the upper bale falls into this space in such a way as to protrude into the lateral aisle, thus slowing or preventing the passage of equipment. It is difficult to control the fall of a bale so as to avoid such a situation, and where it occurs, additional time is required to push the protruding bale back into place. The time thus lost may offset the gain in time otherwise achieved by this method of breaking out the lower bales.

An obvious advantage of the machine method is that only 1 worker is required as compared with 3 or 4 workers by both the manual and manual-boom truck methods. Time and production studies show that the break-out rate usually obtained with the machine method is as high or higher than the rate obtained with the manual-boom truck method, and from 2 to 3 times the rate obtained when bales are broken out entirely by hand. Thus, a change from either of these two methods to the machine method results in substantial savings in labor.

The average break-out rate maintained by the machine method is determined, in large measure, by the skill and training of the operator of the break-out truck. Time studies indicate that a fairly skilled operator might reasonably be expected to break out from 50 to 65 bales per hour by machine, working out of 2-high, head-on-head stacks. An operator having less than fair skill might average between 40 and 50 bales per hour. An operator of superior skill might be expected to exceed 75 bales per hour at least part of the time. Production records of one warehouse show that its best operator often broke out bales at a rate exceeding 100 bales per hour. During one operation which was timed, this operator broke out 40 bales in 18 minutes or at a rate of 133 bales per hour.

Some operators have no difficulty in breaking bales out of and restoring bales into tight stacks. Other operators prefer loose stacks, with some free play between adjoining bales. During one break-out operation observed, where the stacks were fairly tight, the break-out operator was able to maintain a rate about double that of any operator

observed at other warehouses. This fact suggests that a loose stack is not necessarily a requirement for best results.

To indicate conservatively the relative savings that might result from the use of the machine method, and to provide a basis for comparison with the two methods previously described, a machine break-out rate of 50 bales per hour is assumed. At this rate 2 hours of elapsed time, which results in 2 man-hours of labor and 2 machine-hours of lift-truck time, are required to break out 100 bales. By using the assumed wage rate of $1.25 per hour for the lift-truck operator, direct labor costs would amount to $2.50. At $1.25 per hour for owning and operating the lift truck with the break-out attachment, equipment costs are also $2.50. Hence, the total direct labor and equipment costs per 100 bales broken out are $5, or roughly one-fourth of the total cost of the purely manual method and a little more than half (55 percent) of the cost of the manual-boom truck method. Warehousemen whose lift-truck operators have greater skill and can break out at a faster rate should have correspondingly lower costs.

MACHINE METHOD OF BREAKING OUT FLAT BALES STORED 1 BALE AND 3 BALES HIGH ON HEAD

Breaking Out from Rows 1 Bale High

The break-out attachment can, of course, be used to break bales out of rows only 1 bale high—that is, untopped bales. The break-out operation is done in the same manner as that previously described for breaking bales out of storage rows 2 bales high. However, as there are no top bales to impede the operation, the overall break-out rate usually is considerably higher than with stacks 2 bales high. An increase of 25 to 50 percent in the break-out rate is not uncommon.

Breaking Out from Rows 3 Bales High

To handle bales in and out of 3-high stacks, a machine with a lift of 130 inches or more is required. Time studies show that when the machine method is used, a break-out rate of 35 to 40 bales an hour usually may be obtained by a fairly skilled operator. This lowered rate stems mainly from the fact that in a 3-high stack a relatively greater number of obstructing bales usually must be handled in making break-outs. In a stack of this height, there is greater chance that any given desired bale will be covered by other bales. Any such obstructing bales usually must be removed, a bale at a time, before the desired bale can be broken out.

OTHER USES OF THE BREAK-OUT ATTACHMENT

In previous sections of this report the break-out attachment was discussed only in connection with its use in certain types of break-outs of flat bales. In this section the use of the break-out attachment for, or in connection with, other bale-handling operations is discussed.

Spotting

One advantage of the method by which bales are broken out of storage by 1 worker and a machine, is that in some situations it is economical for the machine operator to do the spotting and breaking-out operations at the same time. In such cases, he carries the tag list with him on the lift truck, locates the desired bales by driving the truck down the lateral aisles between the rows of bales, and as each bale is found, breaks it out immediately and delivers it to the set-down area in the main aisle.

Resampling and Reweighing

By use of a machine fitted with a break-out attachment the costs of resampling and reweighing bales, where storage arrangements of the types previously described are employed, may be greatly reduced from those incurred with some other methods. For example, the resampling of a flat bale stored next to a lateral aisle can be done in the aisle at the point at which the bale is located, by first breaking the bale out into the aisle, by means of the attachment, so that both sampling sides of the bale are easily accessible. After the bale has been resampled it can be immediately returned by the machine to its former position in the storage row. Likewise, a bale to be reweighed can be quickly broken out by a machine, carried by it to a temporary scale area in the main aisle, weighed, and restored by the machine.

Breaking Out Compressed Bales Stored 1 High on Head

Although the break-out attachment was designed expressly to handle flat bales, it also has been used successfully to break out compressed bales stored 1 bale high on head in solid blocks from 3 to 6 bales deep from the aisle (fig. 9). To reach any given bale in a storage block of this type, the bales between the desired bale and the aisle first must be set aside. Studies show that by means of a single lift truck equipped with this attachment, bales can be broken out of such storage blocks at rates ranging from 30 to 50 bales per hour. The variation in rates depends primarily on the depth of the storage block and the number and

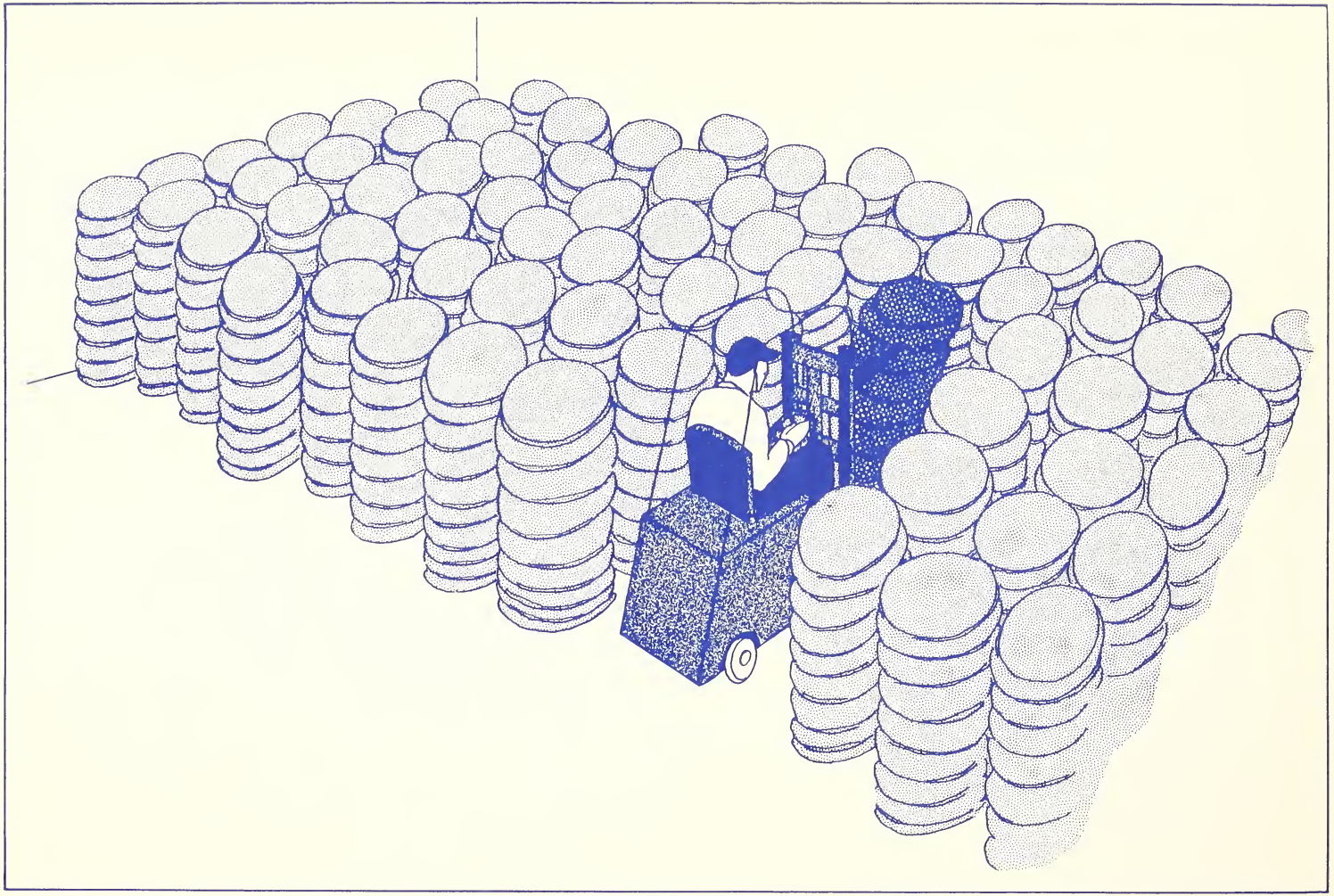

Figure 9.--Machine, using break-out attachment, breaking out a compressed bale of cotton from a block in which bales are stored on head 6 bales deep from the aisle. The obstructing bales between the desired bale and the aisle had previously been removed and set aside by the machine.

location of the desired bales within the block. At these rates substantial savings are possible when compared with the hand method in which a crew of 3 or 4 workers breaks out bales at rates considerably lower than those attained in the machine operation.

Tightening Up

If storage space is needed, most warehousemen tighten up storage blocks or consolidate the bales remaining in a block, after one or more break-outs have been made, to provide space for new bales to be grouped. Tightening up usually is a costly operation because of the difficulty of rebuilding stacks in congested storage areas.

In any situation in which the machine method can be used for breaking out, it also can be used for tightening up. Where flat bales are stored on head along a lateral aisle, the lift-truck operator is able to work from the aisle, rebuilding the old row or stack by shifting outlying bales to open positions closer to the wall, in much the same way and at roughly the same rates as in breaking out. To restore bales in accordance with this procedure requires somewhat greater skill on the part of the machine operator than is required to break them out. However, any reasonably competent operator should be able, with a little practice, to develop enough skill to do this type of operation satisfactorily.

The break-out attachment also is useful in tightening up compressed bales stored 1-high on head. A time study of one operation showed that by using a lift truck equipped with this attachment it is possible to tighten up compressed bales at a rate of from 75 to 85 bales an hour. However, since in many instances this job could be done more quickly and more efficiently by a clamp truck, by which 2 or more bales--rather than 1 bale--may be handled at a time, it may not always be desirable to use the break-out equipment for this purpose.

In many cases where the break-out of flat bales stored on head along a lateral aisle is done by a machine using the break-out attachment, it may be economically feasible, by means of such equipment, to store newly received bales in the spaces thus vacated. The machine does such storing in exactly the same way it restores old bales in such spaces during a tightening-up operation. The storing rates, and therefore the storing costs per 100 bales, approximate those of breaking out. Furthermore, by storing all new bales in this manner the tightening-up operations, which in other situations may precede new storing, can be completely eliminated. Although some warehousemen will prefer such a system because it eliminates tightening-up costs and simplifies the storing of new cotton, other warehousemen may feel that such a practice will complicate their bale locator system and make spotting operations more difficult.

USE OF SAME LIFT TRUCK FOR BOTH BREAKING OUT AND TRANSPORTING

In some situations it may be advisable for a warehouseman to assign one or more lift trucks solely to break-out operations. However, in most situations this use of equipment probably is inefficient, especially if there are other operations in which the equipment can be used. In some warehouses, when the break-out of one or more lots of bales by a machine has been completed, the break-out attachment is replaced by clamps and the same machine is then used to transport these bales from the break-out area to the loading platform, press room, and other points. Thus, the complete job of spotting, breaking out, transporting, and in many cases loading bales into motortrucks or railroad cars, may be done by one operator and one machine. There are, of course, certain advantages in a system in which only one worker and a machine are responsible for carrying out this entire series of operations.

To remove the break-out attachment from the lift truck and mount clamps in its place, or to remove clamps and remount the attachment, requires about 15 minutes. However, additional time may be required for the machine to travel from the work area to the maintenance shop or other point at which attachments may be exchanged and return to the work area. Although special racks and equipment for making the changeover are required for best results, the changeover itself can be performed by any lift-truck operator after a little instruction. This flexibility greatly enhances the value of the equipment to the warehouseman.

SOME FACTORS TO BE CONSIDERED IN THE PURCHASE OF BREAK-OUT EQUIPMENT

If a warehouseman already has on hand a lift truck of proper load capacity available for use in break-out operations, he has only to consider whether or not investment in the break-out attachment, where it is to be used chiefly or solely for break-out purposes, would be worth while. The investment might be considered worth while if the expected savings from the additional use of a lift truck for break-out operations would pay for the new attachment within a reasonable length of time. 10/ The answer to this question largely depends, of course, on the volume of break-outs on which the machine would be used during a season.

If the lift trucks already on hand at a warehouse ordinarily are fully occupied with other operations and are not available for breaking

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10/ The price of the break-out attachment in March 1954 was approximately $650, f. o. b. factory. The price of some cotton topping booms was about $500, although others sold for less. Used boom attachments may in some cases be available from their owners at a much lower cost.

out, the warehouseman must purchase an additional lift truck as well as the break-out attachment if he is to break out by machine. In such a case, the warehouseman must determine whether the savings in break-out costs alone can, within a reasonable time, recover the cost of both the machine and the attachment. 11/ Again, this is largely a question of the volume of break-outs on which the attachment can be used. Of course, if in addition to breaking out there are other handling jobs for which an additional lift truck is needed and could be efficiently used, opportunities for further economies would be provided through the purchase and use of such equipment, and the savings in break-out costs alone need not justify the expenditure.

If lift trucks currently are not being used at a warehouse, the reasons for this--such as the inadequacy of existing physical facilities--may also be reasons why such trucks could not be used for break-out operations. However, the warehouseman may wish to consider whether the additional savings that might result from the use of a more efficient break-out procedure would, in conjunction with savings that would result from the mechanization of other operations, be enough, taken together, to justify an outlay for improvement of the facilities to make use of lift trucks possible.

In some cases warehousemen have on hand equipment whose capacity is less than that recommended for use with the break-out attachment. For example, it is recommended that the attachment be used only on lift trucks of a load capacity of 2,000 pounds or more; yet in many of the smaller cotton warehouses, fork trucks with a load capacity of only 1,000 or 1,500 pounds are used. In many instances the warehouseman's use of smaller lift trucks also may be due to the fact that his facilities are inadequate for the use of heavier equipment. In such circumstances, he should consider whether it might pay him to strengthen his floors or platforms, or otherwise adapt his facilities to the use of heavier equipment, in order to realize the increased savings that could be obtained by mechanizing break-out operations as well as by the more effective mechanization of those operations in which the lighter, less efficient equipment is used. Or he may wish to learn whether his machine could be altered or modified to permit the effective use of the attachment. For advice in these matters he should consult the manufacturer or local distributor of the equipment.

11/ Factory prices for gas-powered, fork-equipped lift trucks were quoted (March 1954) at from about $3,000 for trucks of 2,000-pound capacity to about $4,000 for those of 4,000-pound capacity. The substitution (for the forks) of clamps, break-out devices, or other attachments ordinarily will involve an additional charge.

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